Remarks:

Claim rejections under 35 U.S.C. §103

(a) Claims 1-51 are pending in the application, and were rejected under 35 U.S.C. §103(a) as being unpatentable over Macler[1] in view of Sheehan[2].

(b) With respect to independent claims 1, 14, 27, 35 and 42, the Action states that Macler makes obvious all the limitations therein. There are several significant differences between the teachings of Macler and the claimed invention. The Action fails to distinguish between un-ionized gas clusters and ionized gas clusters in an accelerated ion beam. Macler teaches measuring the sizes of non-ionized gas clusters that are supersonically expanded through an orifice. The present invention measures the size of ionized and accelerated "*gas cluster ion beams.*" This is a significant difference because a supersonic jet of un-ionized gas clusters is not an ion beam and such a jet of clusters travels with velocities on the order 550 m/second, while an accelerated beam of gas cluster ions, such as recited in the claims, travels at a velocity which may be 10 to 100 times faster. Secondly, the mean sizes of ionized gas clusters generally differ from the mean sizes of un-ionized clusters for two reasons: (a) Macler's method of ionizing gas clusters by electron impact[3] tends to change gas cluster sizes by causing fragmentation and/or partial evaporation; and (b) there are different ionization probabilities for gas clusters of varying sizes in an electron impact ionizer (Macler's method), the larger clusters being more likely to be ionized. Accordingly, measuring the size of ion clusters is not the same and does not produce the same results as measuring the size of un-ionized clusters.

The Action asserts that Macler teaches a gas cluster ion beam, citing lines 1-5 of the Abstract. Macler teaches, however, not a GCIB, but rather "argon gas clusters" provided by a

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[1] U.S. Patent No. 5,767,511 issued 16 June 1998 to Macler, Michel

[2] U.S. Patent No. 6,278,111 issued 21 August 2001 to Sheehan, *et al.*

[3] Macler, col. 3, ll. 63-65

cluster sources and subsequent "electron impact ionization" to produce ionized cluster fragments. This is not a GCIB as in the presently claimed invention.

The Action further asserts that Macler teaches a discloses a "*detector that measures the properties of a gas cluster ion beam*". Applicants respectfully suggest that this is not correct. Macler's invention is directed to measuring the sizes of un-ionized gas clusters, such as Argon clusters. The clusters are formed in a cluster source 11[4] that uses supersonic expansion through a sonic orifice combined with a skimmer[5]. Such a mechanism is analogous to the prior art as described in Applicants' specification and depicted in Figure 1 of the present application as cluster-containing gas jet 118 formed by nozzle 110 and skimmer 120. In Macler's system, it is desired to measure the mean size of this un-ionized jet or beam of gas clusters[6]. Macler directs the un-ionized clusters through a pick-up cell 13 filled with water vapor at a measured and controlled pressure. In the pick-up cell, some of the un-ionized gas clusters collide with and capture water molecules that "stick" to the clusters, which then pass out of the pick-up cell – still un-ionized but "doped" with water. After exiting the pick-up cell 13, the un-ionized and doped clusters are now ionized and simultaneously fragmented by electron impact ionization[7]. The ionized fragments (smaller than the original un-ionized Argon clusters) retain the water doping, and are detected and analyzed statistically, using measured fragment intensity variations versus water vapor pressure in the pick-up cell 13, in order to estimate the mean collision cross-section and thus the mean size of the original un-ionized Argon clusters. These are measures of the original un-ionized Argon clusters before they enter the pick-up cell 13 and not measures of the size of the ionized and fragmented clusters formed farther downstream[8]. Thus, Macler's "detector", comprised of pick-up cell 13, gas analyzer 21 and filaments 22 and 23 for ionization and fragmentation of clusters, measures the size of the un-ionized clusters only as they originally

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[4] Macler, col. 3, ll. 2-4

[5] Macler col. 4, ll. 28-31

[6] Macler col. 4, ll. 3-5

[7] Macler col. 3, ll. 62-64

[8] Macler col. 4, ll. 3-5

entered the pickup cell 13. The filaments 22 and 23 are solely for ionizing and fragmenting the un-ionized doped clusters to facilitate a measurement size of un-ionized clusters. Thus, *measurement of the properties of a gas cluster ion beam* is clearly not taught or suggested by Macler.

The Action further asserts that Macler discloses *a dissociating means located within the enclosure adjacent to the first opening for dissociating cluster ions in the gas cluster ion beam.* On the contrary, Applicants respectfully indicate that neither Macler nor Sheehan teach or suggest a dissociating means as in the claimed invention. Macler's pick-up cell 13 clearly does not produce dissociation, because the low velocity jet of clusters does not collide with water molecules at high enough velocity to produce dissociation. In fact, what occurs is that water molecules are captured by the clusters[9]. Macler discloses a spectrometer 21 that includes electron filament 22 and bias filament 23 that are used to ionize and fragment the clusters by electron impact. "Fragmentation" is differs from the *dissociation* recited in the claims, where the term dissociation refers to dissociation to the molecular level[10]. Macler is nonspecific about the sizes of fragments that method produces, but they are clearly identified as gas cluster ions[11] and not as dissociated molecules (*i.e.*, $Ar_nH_2O^+$). Thus, Macler clearly does not teach a *dissociation means*.

The Action also asserts that Macler discloses *a pressure measuring means for measuring the pressure within the enclosure.* Applicants respectfully suggest that this represents a misreading of Macler. Macler teaches a pressure gauge 15 connected to and measuring the pressure in the pick-up cell 13. This gauge measures the pressure of water vapor in the pick-up cell 13[12]. The *pressure measuring means* of the presently claimed invention measures the

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[9] Macler, col. 1, ll. 62-66; col. 3, ll. 46-51, col. 3, ll. 59-62

[10] Applicants' claims 1, 14, 35 "dissociating....into molecules"

[11] Macler, col. 4, ll. 41-43

[12] Macler, col. 3, ll. 4-9

pressure of the gas formed by the dissociated (to the molecular level) clusters – this measurement takes place in the same enclosure where the dissociation occurs.

Specifically with respect to claim 27, Macler also fails to teach *means for operably controlling the relationship* and *beam switching means*. Specifically with respect to claim 42, Macler fails to teach a *method for controlling a gas cluster ion beam processing system* or *adjusting parameters of said gas cluster ion beam processing system.*

(c) With respect to dependent claims 7, 20, 32-33, 42, 47-48 and 50-51, the Action asserts that Macler discloses a pressure measuring ionization gauge. As discussed above, however, Macler's pressure gauge is neither within the enclosure nor does it measure the pressure of a gas comprised of dissociated clusters.

(d) With respect to claims 6, 8-19, 21-31, 34-41, 43-46 and 49, the Action asserts that the failure of Macler to disclose a Faraday cup is overcome by Sheehan's disclosure of a Faraday type charge measuring device located within the enclosure of an apparatus in the path of a gas cluster ion beam that would provide a solid surface on which the gas cluster ions would impact and dissociate.

Applicants respectfully suggest that Sheehan is improperly combined with Macler, and furthermore does not disclose a Faraday cup with an exit opening. Sheehan is directed to technology outside the field of cluster ion beams and gas cluster ion beams, *i.e.*, electrospraying for chemical analysis. Sheehan discloses dissolving a material to be analyzed in a liquid, spraying the liquid from a needle to form an aerosol, and subsequently evaporating (desolvating) the liquid solvent in the aerosol, and ionizing and focusing into an ion beam. It is specifically taught that if any clusters are present in the desolvated aerosol, they are broken up[13] and the ion beam produced is a conventional monomer or molecular ion beam, not a *cluster ion beam*.

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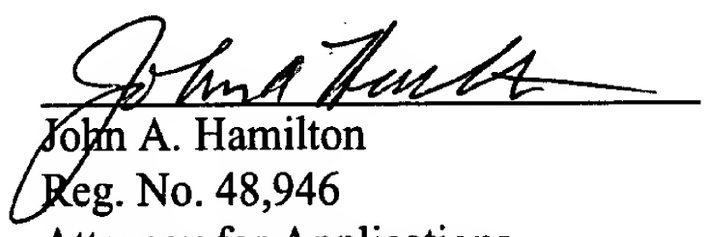
[13] Sheehan, col. 6, ll. 65-67

Figure 2 of Sheehan does not depict a Faraday cup – it shows a schematic section of a quadrupole mass filter (where only two of the 4 poles is drawn[14]. Column 10, lines 35-38 also explicitly state that, in reference to Figure 2, a Faraday is "not shown" and that "A quadrupole mass filter is shown…" Thus, Figure 2 shows a quadrupole mass filter that appears to have an entrance and an exit – this is the conventional arrangement for a quadrupole – through which the ions traverse. Although Sheehan suggests a Faraday cup may be used in the alternative, it does not teach a Faraday cup "with an exit opening." Indeed, according to the conventional form of a Faraday cup known in the art, an exit would not be a purposeful feature, and it is clearly not shown in Figure 2.

For at least the foregoing reasons, Applicants respectfully submit that claims 1-51 have been clearly established as patentable over the prior art of record. Favorable consideration and allowance of the pending claims are earnestly solicited. Should there be any questions after reviewing this paper, the examiner is invited to contact Jerry Cohen or the undersigned at 617-854-4000.

Respectfully submitted,
RICHARD P. TORTI, ET AL.
Applicants

Dated: November 6, 2003

By: 
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(Under 37 CFR §1.34(a))

[14] Since a quadrupole is axis-symmetrical, either two or zero poles show in a section drawing – Figure 2 illustrates two